Beamline 14-BM / BioCARS-CAT

Scientific focus: Structural biology

Scientific programs: Large unit cell (virus) crystallography, small unit cell (protein) crystallography, MAD phasing, time-resolved crystallography, Laue diffraction, and study of microcrystals

Optics & Optical Performance

14-BM-C

- CARS-design conical focusing mirror
  - 25.731 m from source (on orbit along 3 mrad line)
  - Si substrate, Rh coating
  - water cooling at midplane
  - 4.1 mrad design angle
  - horizontal focus: focusing monochromator
  - vertical focus: bender
- CARS-design bent Ge(111) monochromator
  - 46.6 m from source (along 3 mrad centerline)
  - Ge(111) single crystal
  - bent triangle horizontal focusing
- misc. slits, collimators, filters, diagnostics etc.
- energy: capable 7.0–15.0 keV
- energy: operational 12.4 keV (1.0 Å) fixed
- adjustable focal spot 210 μm hor. x 350 μm vert. (nominal)

14-BM-D

- 6.5–18.5 keV energy range, rapid tuning
- focal spot size 0.4 mm hor. x 0.6 mm vert. (nominal) adjustable to 150 μm hor. x 150 μm vert.
- CARS-design Si(111) double-bounce monochromator
  - 23.860 m from source (on orbit along 5 mrad line)
  - 6.5–18.5 energy range Si(111) crystal sets
  - 10^{-4} energy resolution ($\Delta E/E$) at 10 keV
  - 38 mm nominal offset (fixed-exit, up bounce)
  - water cooling
- CARS-design bent cylindrical focusing mirror
  - Si substrate, Rh coating
  - water cooling at midplane
  - 25.731 m from source (var. ht. along 5 mrad line)
  - 4.1 mrad design angle
  - horizontal focus: sagittal cylindrical figure
  - vertical focus: bender mechanism
- misc. slits, collimators, filters, diagnostics etc.

Experiment Stations

14-BM-A

- white beam first optics enclosure
- 8.6 m x 1.8 m x 2.8 m (L x W x H)

14-BM-B

- pink beam optics enclosure
- 7.6 m x 1.2 m x 2.8 m (L x W x H)

14-BM-C

- monochromatic beam station
- 5.2 m x 3.7 m x 2.8 m (L x W x H)
- virus crystallography

14 BM-D

- pink or monochromatic beam station
- 6.4 m x 2.2 m x 2.8 m (L x W x H)
- MAD phasing
- time-resolved Laue (capable)
- protein crystallography

Detectors

- 60° kappa diffractometer (all stations)
- single-axis diffractometer (available)
- ADSC Q1, ADSC Q4, MAR345 and off-line image plate detectors
- solid state, NaI scintillation, and Ge detectors

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Beamline Controls and Data Acquisition

- beamline and experimental control:
  Dell Precision 620/PIII 933
  Red Hat Linux 7.1
  EPICS via VME
  ADSC or Mar control software
- analysis: SGI 02 IRIX 6.5 running HKL/Denzo, DPS/MOSFLM, CCP4, CNS, LaueView, O, Predict, Resolve, Shelx, Strategy, Solve, XtalView, etc.

Beamline Support Equipment/Facilities

- cryo-coolers: Oxford CryoStream, Oxford CryoJet, MSC, and CARS LN_2/LHe_2 Cooler
- collimators, filters, slits, beam stop, CCD alignment cameras
- beam position monitors (1 μm resolution)
- beam flux monitors
- BL3 facility, sample prep areas, cold room
- biochemistry equipment (pH meters, incubator, centrifuge, pipettes, glassware, lab refrigerator, etc.)

Bending Magnet Source Characteristics (nominal)

source	APS bending magnet
critical energy	19.51 keV
on-axis peak brilliance at 16.3 keV	2.9×10^{15} ph/sec/mrad²/mm²/0.1%bw
on-axis peak angular flux at 16.3 keV	9.6×10^{13} ph/sec/mrad²/0.1%bw
on-axis peak horizontal angular flux at 5.6 keV	1.6×10^{13} ph/sec/mradh/0.1%bw
source size at critical energy Σ_x Σ_y	 145 μm 36 μm
source divergence at critical energy $\Sigma_{x'}$ $\Sigma_{y'}$	 6 mrad 47 μrad